

Dr Ferguson 12

With the Compliments of
A. Shaw.

Long Lane, New York, N. Y. Feb. 1.
1847



ON
DEFORMITY OF THE CHEST FROM
DYSPNŒA

To the Editor of the Medical Gazette.

SIR,

THE following observations relate to the case of a child, who was admitted into the Middlesex Hospital on the 11th of this month, in a comatose state, and suffering from violent dyspnœa. As the history obtained from the friends who accompanied the child was obscure, and the patient was threatened with immediate suffocation, tracheotomy was performed: but the patient did not survive more than twelve hours. On dissection, lymph was found in the trachea, and in the larynx on the lips of the *cordæ vocales*. As the reflections to which I was led from witnessing the phenomena of the child's breathing, point to conclusions which may be considered interesting, I venture to send them for insertion in your journal.

I am, sir,

Your obedient servant,

ALEXANDER SHAW.

23, Henrietta Street, Cavendish Square,
October 23, 1841.

Observations on the child's breathing.—

The breathing of this little patient offered an interesting illustration of the effects of the action of the diaphragm upon the forms of the ribs, in laborious respiration.

The breathing was what is called *abdominal respiration*: that is, while the chest, or its principal part, was fixed, the abdomen and diaphragm were in busy, over-wrought exercise.

Such may be taken as a general description of the breathing. But what principally drew the attention of all who witnessed the struggles of the child was, that at every inspiration an extraordinary constriction of the thorax took place, near its lower margin.

Each time that the patient drew in his breath, endeavouring to inflate his lungs, there was a sinking inwards of the sides of the chest, and a deep indentation, about three inches above the lower free margin of the thorax. So considerable was the constriction, that I am not incorrect in saying that, measuring from what might be supposed to be the natural level of the thorax, the hollow may have been as much as three-

quarters of an inch in depth. The indentation followed the curved line that corresponds with the junction of the cartilages with the extremities of the false ribs. It was only observed during inspiration; for, when expiration took place, the ribs, by their elasticity, expanded, and obliterated the constriction.

As to the upper part of the chest, it was particularly full and prominent, being elevated and expanded apparently to its greatest extent. It was also observed that this part was without any perceptible motion. It did not, as in common breathing, rise and fall in correspondence with the action of the diaphragm, but remained elevated and fixed even during expiration. The projection of the sternum and of the front of the chest generally, was so considerable, that the breast was actually gibbous: it presented the form of the chest so commonly seen in children said to be "pigeon-breasted."

From watching the child's breathing, it was obvious that a very small quantity of air was admitted into the lungs. This was judged to be the case, both from the feebleness of the current of air entering the mouth and nostrils, and from the sound heard on putting the ear close to the larynx: there was a faint, scarcely audible, wheezing and siffling sound, that seemed to indicate that the chink of the glottis was all but completely closed up. The child had ceased for some time to be able to expectorate; and, notwithstanding its struggles, could not utter a sound of complaint; in fact, the perfect silence of the sufferer during the protracted operation, had an inexpressibly painful effect on the feelings of the bystanders.

As soon as the tube was introduced into the trachea, and the breathing became tranquil, the chest was restored to its natural form; the upper part ceased to be so much elevated as it had been; and the constriction below disappeared*.

After noticing the above phenomena, it becomes a question of considerable interest—what could have given rise to the remarkable sinking inwards of the

* I may state that in a child on whom I had to perform laryngotomy several months ago, owing to threatened suffocation from the effects of swallowing boiling water, I observed a similar condition of the chest to that described in the text; but I omitted to take notes of the case.

lower part of the chest, during each act of inspiration, in this patient? When, considering the laborious condition of the respiration more particularly, we should have expected to find every part of the chest, each time that the child inspired, both elevated and expanded to the greatest possible extent, how did it happen that, at each inspiration, instead of the ribs being dilated, the extremities of all the false ribs were drawn in, so as to imitate the act of expelling the air, and produce a visible constriction, amounting to a deep indentation, in the sides of the chest?

When I first observed the constriction, it reminded me of the appearance of the chest presented in Mr. S——, whose case is related by me in one of the former volumes of the *MEDICAL GAZETTE*, and has been introduced by Sir Charles Bell into his work on the Nervous System*. In this patient, although the affection had a totally different origin from that of the child, there was a drawing inwards of the lower margin of the chest, and constriction of the waist, resembling considerably the appearance which I have described in the child. When offering an explanation of the condition of the thorax in Mr. S——, I was led to conclude that the sinking inwards of the border of the chest was an effect of the fibres of the diaphragm acting, in a peculiar condition of the other muscles of inspiration, upon the lower cartilaginous border of the thorax to which they are attached. It has to be remarked, that in the natural action of breathing, owing to the mobility of the margin of the chest, and to the fibres of the diaphragm which arise from it converging to be inserted in the central tendon, there is a tendency in the cartilaginous border, each time that the diaphragm contracts, to be operated upon as a moving part, and to be drawn inwards, in the direction of the central tendon. But this drawing in of the flexible boundary of the chest, during the act of inspiration, it need scarcely be said, if allowed to take place, would be an imperfection; inasmuch as the transverse diameter of the thorax would be diminished, and the cavity of the chest contracted in size, when it was the object to dilate it

in every direction*. The occurrence is guarded against by the intercostal muscles, assisted, at certain times, by the large muscles that lie upon the outside of the thorax, not only elevating the ribs, but, by a partial rotation of them, expanding them laterally, and holding the margin of the thorax firmly out, so as to resist the fibres of the diaphragm acting in the direction of the centre. It may readily be conceived, however, that if, owing to some peculiar nervous derangement, the muscles whose office it is to dilate the border of the chest, and in that respect antagonize the diaphragm, were deprived of their natural power, while the diaphragm continued to act with its usual force, the fibres of this muscle, by contracting from the central tendon as their origin, upon the pliant ribs as their insertion, would have the effect of pulling the free margin of the chest inwards, and causing a constriction of the waist to take place. In the case of Mr. S——, it was observed, by carefully attending to the state of the muscles on the outside of the chest, that they were incapable of combining with the diaphragm in the associated action referred to; that, so far as that peculiar office was concerned, they were paralysed. Hence the conclusion was drawn, that it was owing to this defect, and the absence of opposition on the part of the muscles which elevate and dilate the chest, that the constriction of the waist was produced by the action of the diaphragm. Now, when a similar sinking in of the lower part of the chest was presented in the child the subject of these observations, I was at first led to believe that the appearance might be explained in nearly the same manner. The intercostal muscles, and their auxiliary muscles situated on the outside of the thorax, I supposed, although not deprived of their natural power, might, nevertheless, considering the violently laborious condition of the child's breathing, be too feeble to resist the action of the central fibres of the diaphragm. Remembering the flexibility

* *MED. GAZETTE*, January 7, 1833; Nervous System, 1836, p. 427.

* There would also be an imperfection in the act of expiration. As the diaphragm relaxed, the ribs would be relieved from their previous constriction: they would consequently start outwards by their elasticity, and thereby cause more or less *dilatation* of the chest to take place at a time when it was the object to contract the cavity of the chest.

and pliancy of the chest in a child so young, it did not seem improbable that the muscles alluded to were unable to hold out the margin of the chest against the powerful operation of the fibres of the diaphragm dragging it inwards; and that the constriction observed each time the diaphragm contracted, resulted from that cause.

But, reflecting more maturely on the appearances, I am now induced to think, that, in order to make the explanation satisfactory, another interesting circumstance must also be taken into account.

It has been said, that, on watching the child's breathing, it appeared that, notwithstanding the labour of respiration, only a small quantity of air was admitted, at each inspiration, into the lungs. There were grounds for supposing that the rima glottidis was obstructed to such a degree that it was all but closed. Let it be granted that what was here conjectured to be the case actually happened; and that when the child endeavoured to inflate the lungs, so far was he from succeeding in doing so, that only a small quantity of air—a quantity inadequate to fill the lungs completely—entered the chest; what would be the effect on the form of the chest? Or, putting the question in other words, suppose the thorax operated upon in a natural manner, so as to have its cavity enlarged at each inspiration to its usual degree, while, at the same time, owing to an obstruction in the larynx, the lungs could not be distended so as to occupy the increased space which the expansion of the chest tended to form for them—what change would this give rise to in the form of the chest?

Is it not evident that the first effect would be, to give rise to a tendency for a vacuum within the thorax, disproportioned to the expansibility of the lungs, being produced? In ordinary breathing, the vacuum, it is well known, which tends to be formed by the dilatation of the chest during inspiration, always bears an exact relation to the capacity of the lungs for containing air. The cavity of the thorax is never enlarged to a greater extent than the lungs distended with air are capable of occupying. Hence an equal balance is maintained between the pressure of the atmospheric air within the thorax,

and that which operates from without; and the parietes of the chest, flexible and yielding as they may be, do not undergo any compression from the external atmosphere. But if the natural relation here adverted to were disturbed; if the chest and the lungs did not expand to an equal degree; if, while the chest was enlarged in its area to a large amount, the lungs were only slightly and imperfectly distended; is it not obvious that a vacuum in the space intervening between the parietes of the thorax and the lungs would tend to be produced? But if this be admitted, since we know that such a thing as a vacuum cannot be formed, we must conclude that the atmospheric air would press from without upon the sides of the chest, and by this means counteract the influence of the muscles of inspiration: the external atmosphere would compress the chest where it was most flexible and yielding, that is, at its lower and cartilaginous part, so as to produce a sinking inwards of both sides: and in this manner the area of the chest would be reduced to a size corresponding with the capacity of the lungs. Hence we might expect that, from this cause, a visible change would be produced on the form of the chest; namely, a depression on both its sides, near its lower margin.

This is the explanation which I am disposed to give of the remarkable constriction of the parietes of the chest that took place during inspiration, in the child. It may be that, to a certain degree, the appearance referred to was owing to the fibres of the diaphragm which diverge from the central tendon to the cartilaginous border of the chest, each time that the muscle contracted, pulling the lower border inwards. But I am induced to believe that the constriction resulted mainly and principally from the dilatation of the lungs not being commensurate to the force employed in endeavouring to expand the chest; and to the more pliant parts of the thorax giving way, therefore, to the outward pressure of the atmosphere. The action of the diaphragm in enlarging the long diameter of the thorax, exceeded in power that of the intercostal and subsidiary muscles of inspiration—to which, in this case, belonged the office, not only of expanding the flexible ribs and cartilages against the undue pressure of the external air, but

of holding out the margin of the chest in opposition to the central fibres of the diaphragm. Such, I conceive, was the reason why the diaphragm was able to descend and protrude the abdomen at each inspiration; while, at the same time, the sides of the chest were drawn inwards in the remarkable manner that has been described.

I should not, perhaps, have dwelt so long on this subject, had it not appeared that the explanation here offered of the phenomena in the child's breathing, tended, and I may say rather unexpectedly, to throw light on the origin of a deformity of the chest which has not hitherto, in my opinion, been satisfactorily accounted for by any author.

It has been said that the sinking inwards of the ribs, in this patient, gave rise, each time that it occurred, to an appearance of the chest similar to that of a child said to be *pigeon-breasted*. Owing to the depression of the ribs and cartilages on each side of the sternum, that bone protruded præternaturally at every act of inspiration. Now it may be conceived that if, in consequence of some disease of a less severe nature than the complaint which carried off the child, the breathing was impeded, and the affection lasted for a considerable period, the obstruction not being so serious as to interfere sensibly with the natural functions, a want of correspondence was produced between the inflation of the lungs on the one hand, and the expansion of the chest, by the diaphragm, on the other, a change in the form and development of the chest might, in process of time, especially if the patient were young, and the bones soft and flexible, be effected, by the continued operation of the causes to which I have been directing attention. For example, it is not improbable that, if there were some habitual difficulty of filling the lungs with air, such as from any swelling situated about the larynx or trachea, obstructing the wind-pipe, the action of the diaphragm might be disproportioned to the quantity of air admitted, and the sides of the chest would be consequently pressed inwards, so as eventually to impart to it, as a permanent form, the particular shape which was seen in the child during every act of inspiration.

This idea receives a remarkable con-

firmation from the fact, that it has been generally observed that the pigeon-breasted form of the chest was a frequent concomitant of enlargement of the tonsils in children. In a Memoir treating of this particular conformation of the chest, Dupuytren has made the following remark. "One singular circumstance," he says, "connected with the deformity in question is, that we find it almost constantly accompanied with considerable enlargement of both tonsils." But he goes on to observe: "the relation which subsists between enlargement of the tonsils, and a sinking in of the sides of the chest, is a thing which we cannot yet comprehend*." I remember being much struck with the gibbous appearance of the breast in a young patient, who had been subject, for some time, to difficulty of breathing from enlarged tonsils; and in whom, owing to the urgency of the symptoms, and the impossibility of excising the amygdalæ under the circumstances, I was obliged to perform laryngotomy. But looking also generally to the question, my experience coincides with that of other observers on the subject.

Now, although it may not be satisfactory to explain the origin of the "pigeon-breasted" form of the thorax in every instance, on the principle which I have here endeavoured to illustrate, yet it will perhaps be admitted that it is a mode of explanation applicable to a considerable majority of such cases. The source of obstruction may not always be in the amygdalæ; for the same effects might proceed from enlargement of the thymus gland, or other glands situated in contact with the trachea. In conclusion, I may be allowed to express a hope that, if the observations here offered be thought well founded, they may lead to the adoption of improvements in the plans for remedying the deformity referred to; and that we may have it in our power, in a greater number of cases, to prevent the occurrence of so important a defect in the growth of young persons, as a want of the proper development of the lungs and of the parietes of the chest, which accompanies the progress of this particular kind of distortion.

* Répertoire d'Anatomie et de la Physiologie, tom. v. p. 112.

